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| http://ed.fnal.gov/trc_new/tutorial/graphics/pbl.gif | **Tutorial on Problem-Based Learning**  **Background** |

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**Introduction**

**Find the Problem:**

* The study is planned and directed by the students and facilitated by their teacher.
* Students collect data and analyze and compare it with other datasets.
* Students use a problem-based learning (PBL) strategy.
* Students use technology (i.e., Internet, word processing, interactive charts and graphs, etc.) in their work.
* Students work in cooperative learning groups simulating a research mode in which scientist engage.

**Meet the Problem:** The research question is ill-structured in nature and must be thoroughly analyzed by investigation, inquiry and experience before it can be solved.

**Frame the Problem:** Students will need to collect the "missing components"- information not provided but necessary for a viable solution. As part of this process, students will gather data, hypothesize, prioritize, organize and analyze through methods that include:

* Relating "hunches" and determining fact from opinion.
* Assessing what is known by critical analysis.
* Developing an action plan that is a product of many minds.
* Gathering information/organizing/sharing information from various special focus groups.
* Generating preliminary solutions based on information interpreted in action groups through cooperative learning strategies such as jigsaw.
* Revisiting the problem and analyzing solutions from various focus groups critically to determine viability.
* Assessing/Debriefing to make certain that all special interest groups are heard.
* Solving the problem appropriate to conditions of problem - cooperation, compromise, common sense!

**More Information on PBL:**

* [Characteristics](http://ed.fnal.gov/trc_new/tutorial/pbl.html#anchor482983)
* [Benefits](http://ed.fnal.gov/trc_new/tutorial/pbl.html#anchor471579)
* [Potential Problems](http://ed.fnal.gov/trc_new/tutorial/pbl.html#anchor487665)
* [How Does It Look in the Classroom?](http://ed.fnal.gov/trc_new/tutorial/pbl.html#anchor478820)
* [Socratic Questioning](http://ed.fnal.gov/trc_new/tutorial/pbl.html#anchor490247)

**Characteristics of Problem-Based Learning**

Problem-based learning requires an artful combination of the following components. A skilled teacher/facilitator recognizes the value of each step and takes the time for proper preparation, assimilation, involvement, and development of the outcomes.

The following characteristics have been identified by W. J. Stepien and S. A. Gallagher:

* **Reliance on problems to drive the curriculum** - The problems do not test skills; they assist in the development of the skills themselves.
* **The problems are truly ill-structured** - There is not meant to be one solution, and as new information is gathered in a reiterative process, perception of the problem, and thus the solution, changes.
* **Students solve the problems** - Teachers are the coaches and facilitators.
* **Students are only given guidelines for how to approach problems** - There is no one formula for student approaches to the problem.
* **Authentic, performance based assessment** - is a seamless part and end of the instruction.

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**Problem-Based Learning - What Are the Benefits?**

Using PBL as a strategic tool in the classroom entails the development of the teacher as facilitator of learning, the class as strategic learners and problem solvers, and the district as an innovator and embracer of productive, progressive education. Effective PBL strategies will result in the following benefits for the teacher, the classroom, and the district:

* Problems encountered resemble the nature of problems encountered in the real world. Problems provide clues, context, and motivation; they are the maps which guide learners to useful facts and concepts.
* Since the problem cannot be clearly approached on the first encounter, it becomes a challenge, promoting creative thinking and developing organizational skills.
* Prior knowledge provides a foundation for establishing a framework for extending learning opportunities for all parties involved in the process.
* Misconceptions about teaching and learning, curriculum, math and science instruction, and learner content level understandings are revealed.
* The legitimacy of the group's as well as the individual's learning goals are established.
* The process empowers the group (student and educator alike at their own level) to assume responsibility for directing learning, defining and analyzing problems, and constructing solutions.
* Transfer of knowledge and skills is enhanced through the use of multiple tasks and problem concepts to help form functional abstractions.
* Participants are instructed in becoming responsible members of a learning community by active participation in the PBL process.
* The PBL process models a strategy that can become a foundation for a life skill- vocational training for future problem solvers.
* Common understandings and unexamined assumptions are articulated district-wide as the PBL process is employed - providing direction and opportunities for staff development activities for the future.

Very simply stated, PBL develops students who can:

* Clearly define a problem from an ill-structured situation.
* Establish and prioritize learning issues, separating fact from opinion.
* Develop alternative hypotheses through group brainstorming and mind mapping.
* Access, evaluate, and utilize data from a variety of sources - electronic resources playing a major role.
* Alter initial hypotheses after research and evaluation of new information.
* Develop clearly stated solutions that fit the problem and its inherent conditions, based on sound research and logical interpretation of this information in a group setting.

Problem-Based Learning was first established as part of the education of physicians in medical school and has been an educational institution at Southern Illinois University for over 30 years. Developed by Howard Barrows, this strategy has grown into an instructional approach which is finding success in elementary through high school throughout the state of Illinois and beyond. While its preliminary success has been documented through Illinois Math and Science Academy, PBL is now a prominent strategy in many elementary schools through high schools.

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**Potential Problems in Problem-Based Learning**

**Students:**

* Students trained in a traditional approach to learning/teaching may encounter a true "cultural change." As the teacher moves from the role of "sage on the stage" to a facilitator and coach, students may become confused and frustrated.
* Students will wish to know and understand the expectations for a high grade. Construction of a rubric will help to allay fears.
* Students must learn to be part of the group. Cooperative learning groups, if they are effectively monitored, will allow students to contribute within a given role.
* Students must feel "ownership" of the problem. They should be more concerned about solving their problem than worrying about what the teacher wants.

**Teachers:**

* Teachers will need to learn how to facilitate learning by "second-guessing" research needs, ensuring that there are ample materials (in print, online, and through human resources). Momentum must be maintained by careful preparation of materials.
* Teachers will also need to accept and applaud independent study that may appear chaotic and disjointed at times. A careful eye will be needed to discourage a learner's direction into a "dead end" while not appearing to direct learning - effectively killing the concept of student ownership.
* "Ill-structured" problems must be relevant to the students. Look for "windows" into students' thinking.
* The problem scenario must challenge student's initial hypotheses. Students then will develop an action plan to carry out the process.
* PBL takes time. Each stage must be completed thoroughly as the scaffolding of learning is built. Rushing the process will undermine the results.
* The scenario must be complex. Teachers must avoid oversimplifying, offering too much advice, or providing students with too many key variables.

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**PBL Socratic Questioning**

**The Role of Questioning in Problem-Based Learning**

The use of open-ended, probing questioning when initiating and perpetuating inquiry into the ill-structured problem is a key component to the success of the PBL experience. A strategy known as Socratic questioning is designed to elicit a wealth of ideas and facts from any group. When using Socratic questioning with younger audiences, considerable patience, coupled with a warm and inviting classroom atmosphere is essential. Socratic questioning promotes synthesis of information into discernible categories of "fact" and "opinion." This strategy will attempt to:

* Raise basic issues.
* Probe beneath the surface.
* Pursue problematic areas of thought.
* Help participants discover the structure of their own thoughts.
* Help participants develop a sensitivity to clarity, accuracy, and relevance.
* Help participants arrive at judgments based on their own reasoning.
* Helps participants note claims, evidence, conclusions, questions at issue, assumptions, implications, consequences, concepts, interpretations, and points of view . . . all considered to be the elements of thought. (Paul, 1993)

While it is difficult to establish a concrete format for questioning within a variety of circumstances, Socratic questioning includes a taxonomy of questions that may be utilized diagnostically as the teacher/facilitator moderates discussion and verbal inquiry. The categories are as follows:

* Clarification
* Probe assumptions
* Probe reasons and evidence
* Reveal differing viewpoints and perspectives
* Probe implications and/or consequences
* Used for responding to questions

Even young children can appreciate the value of listening skills and respecting the views of others. Participants involved in the PBL experience must be willing to:

* Listen carefully to each other, and take the issues and comments seriously.
* Thoughtfully reflect on the issues and look beneath the surface.
* Look for reasons, evidence, assumptions, inconsistencies, implications and/or consequences, examples or counter-examples, and respect other perspectives.
* Seek to differentiate knowledge from beliefs (facts from opinions).
* Maintain a "healthy" level of skepticism, or play "devil's advocate."
* Remain open-minded, and not allow themselves to "shutdown" when the views of others do not match their own.

[**A Taxonomy of Socratic Questions**](http://ed.fnal.gov/trc_new/tutorial/taxonomy.html)